ISO Registered Company

MODEL HP-1+6+S

HIGH PRESSURE DIFFERENTIAL REDUCING REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The Model HP-1+6+S is a heavy duty, high pressure differential reducing regulator used to control differential pressure between downstream outlet (P_2) pressure and a loading (P_{LOAD}) pressure to the spring chamber. This unit applies to Cashco drawing nos. 32911 (Non-NACE construction), 32909 (CS NACE construction), or 32907 (SST NACE construction). Sizes are 1/2", 3/4", and 1-1/2" (DN15, 20, and 40). This unit is most commonly applied to develop a constant differential pressure across a rotating shaft seal to provide proper sealing and lubricating conditions over varying pressure ranges. Refer to Technical Bulletin HP-S-DIFF-TB for design conditions and selection recommendations.

⚠ CAUTION

NOT FOR STEAM SERVICE. NOT FOR OXYGEN SERVICE.

SECTION II

II. INSTALLATION

This unit was designed and is used almost exclusively on compressor and turbo expander seal gas systems. **REFER TO COMPRESSOR / EXPANDER MANUFACTURER'S MANUAL FOR DETAILED INSTALLATION, START-UP AND SHUTDOWN OF THIS UNIT.** Install regulator in accordance with direction of flow arrow cast on body (1).

⚠ CAUTION

Option-1+6 contains single diaphragm construction. In the event of diaphragm failure, the process fluid will mix with the loading fluid. Please alert your representative so an alternative product can be selected.

⚠ CAUTION

Installation of adequate overpressure protection is recommended to protect the regulator from overpressure and all downstream equipment from damage in the event of regulator failure.

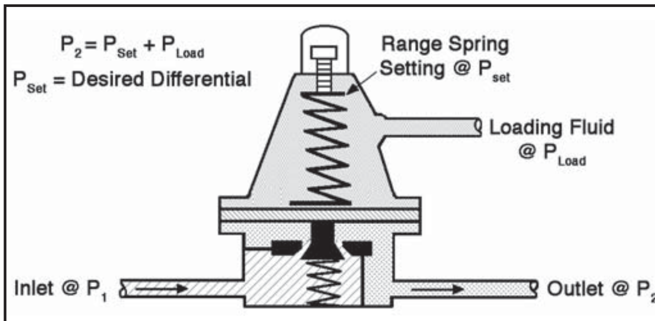
⚠ CAUTION

For welded installations, all internal trim parts, seals and diaphragm(s) must be removed from regulator body prior to welding into pipeline. The heat of fusion welding will damage non-metallic parts if not removed. NOTE: This does not apply to units equipped with extended pipe nipples.

SECTION III

III. PRINCIPLE OF OPERATION

1. The HP-1+6+S is used to maintain a constant differential pressure across the seals of a compressor/expander. A differential pressure reducing regulator senses the downstream or outlet (P_2) pressure on the lower side of the diaphragm and is opposed by the force of the range spring plus an additional loading (P_{LOAD}) pressure connected to the spring chamber. The loading (P_{LOAD}) pressure plus the range spring (14) setting (P_{SET}) equals the outlet (P_2) pressure of the regulator. The range spring setting (P_{SET}) is the differential setting.



HP-1+6+S
DIFFERENTIAL SCHEMATIC

2. A complete diaphragm failure will cause the regulator to fail open.

> **⚠ CAUTION**
>
> **Limit any field hydrostatic test to 1-1/2 times the Maximum Outlet and Spring Chamber Pressure Rating (See Table 2 in HP-S-DIFF TB). Ensure that the test pressure is applied uniformly to the body inlet, body outlet, and spring chamber.**

SECTION IV

IV. STARTUP

REFER TO THE COMPRESSOR / EXPANDER MANUFACTURER'S MANUAL FOR DETAILED START-UP OF THIS UNIT.

*** NOTE:** *Systems sequencing operations at startup, normal operation, failure mode(s), and shutdown must assure that the pressure (P_{Load}) on the spring chamber does not exceed the pressure registering on the wetted side of the diaphragm. Should this "pressure reversal" occur, particularly to metal diaphragms, the diaphragm may be permanently damaged and cause improper operation.*

$$P_1 > P_2 > P_{Load}$$

Pressure reversal is normally caused by the inlet pressure to a regulator being interrupted (automatically or manually).

1. On initial start-up with your system operating at normal conditions, check the differential gauge to ensure the desired differential pressure is being maintained. If not, go to step 2 and make one final adjustment. (This should only be necessary on first start-up.) ***NOTE:*** *It is crucial that the adjusting screw (6) threads not be damaged. Do not use any type of pliers on the adjusting screw (6).*

2. To adjust differential setting, use one of the two following methods: (***NOTE:*** *Both methods require a flowing condition.*)

   a. Loosen the closing cap (28) by turning CCW (as viewed from above) 3 to 4 complete revolutions. Loosen lock nut (7) by turning CCW until it is tight (double-nutted) against closing cap (28). Now the differential setting may be adjusted by turning the closing cap (28) CW to increase differential or CCW to decrease. After desired setting is reached, loosen lock nut (7) from closing cap (28) and tighten each securely to spring chamber (2).

   b. Remove closing cap (28) from adjusting screw (6) by turning CCW. Loosen lock nut (7) by turning CCW. Adjust the differential setting by turning the adjusting screw (6) CW to increase differential pressure or CCW to decrease. Tighten lock nut (7) securely to spring chamber (2). Replace closing cap (28) and tighten.

SECTION V

V. SHUTDOWN

REFER TO THE COMPRESSOR / EXPANDER MANUFACTURER'S MANUAL FOR DETAILED SHUTDOWN OF THIS UNIT.

SECTION VI

VI. MAINTENANCE

⚠ WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the regulator from the system and relieve all pressure. Failure to do so could result in personal injury.

A. General:

1. Maintenance procedures hereinafter are based upon removal of the regulator unit from the pipeline where installed.
2. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.
3. Refer to Figure 3 for view of regulator.

⚠ WARNING

SPRING UNDER COMPRESSION. Relieve spring compression prior to removing diaphragm flange bolts. Failure to do so may result in flying parts that could cause personal injury.

⚠ CAUTION

<u>DO NOT ATTEMPT TO REMOVE ADJUSTING SCREW (6) FROM TOP OF SPRING CHAMBER (2)</u>. The adjusting screw (6) is threaded upward from inside the spring chamber (2). The CCW rotation used to relieve range spring (14) tension will come to a stop. At the stopping point, do not apply any torque to adjusting screw (6) or damage may occur and render the unit inoperable. See Figure 1.

B. Diaphragm Replacement:

1. Securely install the body (1) in a vise with the spring chamber (2) directed upwards.
2. To relieve range spring (14) compression, remove closing cap (28) by turning CCW. Remove lock nut (7) by turning CCW. Turn adjusting screw (6) CCW until range spring (14) compression is relieved. **NOTE: See CAUTION C)**.
3. Draw or embed a match mark between body (1) casting, body spacer (24), and spring chamber (2) casting along flanged area.
4. Remove all body flange hardware (9,23,34,35).
5. Remove spring chamber (2), range spring (14), spring button (4), pressure plate (3), body spacer (24), diaphragm (12), and o-rings (30).

⚠ CAUTION

When body flange hardware (9,23,34,35) is removed from this unit it should always be replaced with new. The new hardware (9,23,34,35) must have the proper grade specification identification markings <u>and</u> meet the following standards:

1. All cap screws (23) and flange stud nuts (9) must have "heavy hex heads".

2. All studs (34,35) and cap screws (23) must comply with or exceed the requirements of ASTM A-193, Grade B7.

3. All flange stud nuts (9) must comply with or exceed the requirements of ASTM A-194, Grade 2H.

New body flange hardware (9,23,34,35) may be purchased from Cashco, Inc. or through the OEM.

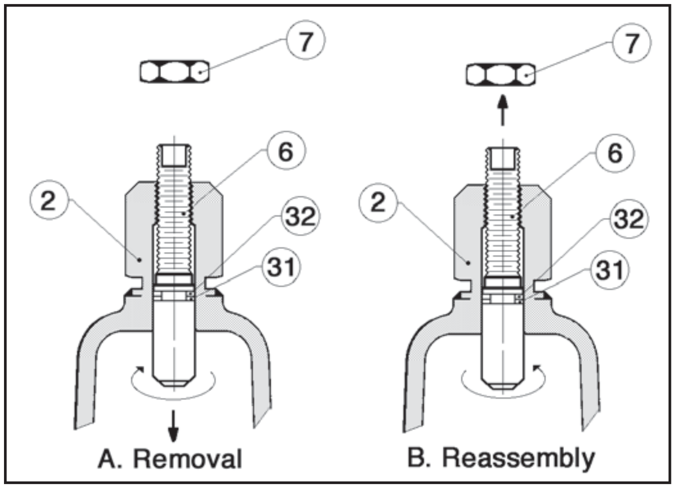


Figure 1: Adjusting screw (6) o-ring inspection.

6. **<u>Adjusting screw (6) o-ring inspection</u>**:

   a. With locknut (7) and closing cap (28) removed, turn adjusting screw (6) CW as far as possible by turning flats on top end. Carefully reach inside spring chamber (2) and grasp adjusting screw (6) by hand. ***NOTE:*** *For 1/2" (DN15) and 3/4" (DN20) size regulators a small piece of plastic tubing with a 3/4" (19 mm) inside diameter may be used to grasp the adjusting screw (6).* Complete adjusting screw (6) removal by rotating CCW. See Figure 1.

   b. Inspect the backup ring (32) and quad ring (31) for wear. If nicked or torn - replace. ***NOTE:*** *Make certain the Teflon backup ring (32) will insert into spring chamber (2) before the quad ring (31). (See Figure 3 blow-up illustration). Make sure the quad ring (31) is on straight with no twist. Use a good grade lightweight grease on both ring seals (31,32).*

c. Lubricate adjusting screw (6) threads. Carefully reinstall the adjusting screw (6) up into the spring chamber (2) by rotating the adjusting screw (6) CW until top of adjusting screw (6) protrudes from top of spring chamber (2). ***NOTE:*** *Care should be taken when holding and rotating the adjusting screw (6) so the quad ring (31) and backup ring (32) are not inadvertently nicked or torn.* Grasp top of adjusting screw (6) and turn CCW until rotation stops **(see CAUTION C)**. See Figure 1.

d. Loosely install lock nut (7) and closing cap (28).

7. Inspect pressure plate (3) for defects due to over-pressurization. Replace if defective.

8. Clean all parts to be re-used according to owner's procedures.

9. Place first o-ring (30) on body (1) and lubricate with a lightweight multi-purpose grease. Position body spacer (24) on body with match marks aligned. Place pusher plate (11) on body spacer (24) and check for vertical movement. ***NOTE:*** *The vertical movement should be free and unobstructed as the pusher plate (11) is pushed down and the lower piston spring (17) contracts and expands. If movement is not free, go to Subsection C following to inspect the inner trim parts.*

10. Place second o-ring (30) on body spacer (24) and lubricate with lightweight multi-purpose grease. Position diaphragm (12) on body spacer (24) inside of o-ring (30).

11. Visually center the pressure plate (3) on diaphragm (12). Place range spring (14) onto retainer hub of pressure plate (3).

12. Place multi-purpose, high temperature grease into depression of spring button (4) where adjusting screw (6) bears. Set spring button (4) onto range spring (14); ensure spring button (4) is laying flat.

13. Using "NEW" studs (34,35) and nuts (9) **(see CAUTION D)**, thread a nut onto each stud approximately 1.25" (32 mm). Drop the studs (34,35) with nuts (9) through the holes in spring chamber (2). (This will assist in keeping the spring chamber (2) centered on body (1) and prevent parts from moving during re-assembly).
Using the "match marks" made in Step 3 as a guide, replace spring chamber (2) onto body spacer (24). Thread on lower nuts (9) and tighten by hand. Adjust length of studs (34,35) by using the top nut (9) so that there are at least 3 to 4 threads protruding from the lower nut.

    Torque body flange hardware (9,23,34,35) using small increments in a 180° alternating pattern until flange mating surfaces of body (1), body spacer (24) and spring chamber (2) are metal to metal. This creates a "fixed compression" on the diaphragm (12) and o-ring (30) seals. Recommended torque values are listed in Table 1.

TABLE 1

Body Size in. (DN)	Item No.	Thread Size	Torque Values Ft-lbs (N-m)	
1/2"-1" (15-25)	9,23,34	3/8"-24	35-40	(47-54)
1-1/2" (40)	9,23,34,35	7/16"-20	55-60	(75-81)

14. With locknut (7) tight against closing cap (28), turn closing cap (28) CW until tension is applied to range spring (14).

15. Proceed to Section D. for bench test.

C. Trim Replacement:

NOTE: *Do not release tension on range spring (14). (Only necessary when removing spring chamber). The range spring (14) tension keeps pusher plate (11) in alignment and assures proper fit upon replacement of trim.*

1. Install body (1) in a vise with the body cap (5) on top and spring chamber (2) downwards.

2. Loosen and remove body cap (5). ***NOTE:*** *Piston spring (17) may stick in body cap (5) when removing.*

3. Remove piston spring (17), piston (15) and cylinder (16). Inspect parts for excessive wear, especially at piston (15) seat surface. Ensure there are no nicks or foreign particles embedded in the piston (15) TFE seat. Replace piston w/ TFE seat (15) if necessary. Inspect the backup ring (27) and quad ring (26) on piston (15). Replace rings if worn, nicked, or depressed.

4. Remove body cap O-ring (25). Clean contacting surfaces of body (1) and body cap (5). <u>Be careful not to scratch either surface</u>. Inspect inside surface of the body cap for scratches or nicks. These could result in leakage past the quad ring (26) and backup ring (27). If worn or scratched replace body cap (5).

5. Clean debris from within the regulator body (1) cavity. Make certain the old cylinder gasket (18) is cleaned out of the body (1) recess. Clean all parts to be reused according to owner's procedures.

6. Reinstall a new cylinder gasket (18). Press firmly and evenly into place using the cylinder (16). Do not use a “homemade” cylinder gasket. Pipe sealant may be lightly coated to the gasket (18) surfaces prior to installation. Inspect to see that cylinder gasket (18) is completely pressed into place and cylinder (16) is centered with body cap (5) opening.

7. Install a new back up ring (27) and quad ring (26) on piston (15). Make certain the teflon back up ring (27) will insert the body cap (5) first, before the quad ring (26) (See Figure 3). Make sure the quad ring (26) is on straight with no twist. Use a good grade lightweight grease on both ring seals (26,27). Slide piston (15) into cylinder (16).

8. Place piston spring (17) into the cavity of the piston (15).

9. Insert new body cap o-ring (25) into groove of body cap (5). Use a good grade lightweight grease on body cap o-ring (25). Use pipe thread sealant applied to the body cap (5) threads. Screw body cap (5) into body (1). Impact until body cap (5) is metal to metal against body (1) at the body cap (5) shoulder.

D. Bench test for suitable operation (Test Fluid: Air or compressed gas).

NOTE: *Regulators are not tight shutoff devices. Even if pressure builds up beyond setpoint, a regulator may or may not develop tight shutoff.*

1. Check for internal trim leakage: With No. 1 shut-off valve closed and No. 2 shut-off valve cracked open, turn on inlet operating pressure. Follow instructions from SECTION IV-2. and set a differential pressure of 20 psig (1.4 Barg) in the downstream line (No. 2 Gauge). Close No. 2 shut-off valve and check for tight shutoff. ***NOTE:*** *Seat leakage not to exceed 15 bubbles per minute. Do not allow excessive buildup if seat leakage exists (crack open No. 2 shut-off valve to prevent buildup).* If seat leakage is excessive, proceed with the following steps to determine location of leak:

   a. Close No. 1 shut-off Valve.
   b. Turn off inlet operating pressure (P_1).
   c. Remove entire topworks per SECTION VI-B., steps 1-5.
   d. Turn inlet operating pressure (P_1) on.
   e. Spray liquid leak detector in the space between cylinder (16) and body (1) to check for cylinder gasket (18) leakage.
   f. Pour a few drops into recess along piston post (15) to check for seat leakage.
   g. Fill the recess to check for quad ring (26) leakage.

   Once location of leak is detected, proceed to SECTION VII-6 for Cause/Remedy and SECTION VI-C. for internal trim replacement. After leak is remedied, proceed to SECTION VI-B., steps 8-15 to reassemble topworks.

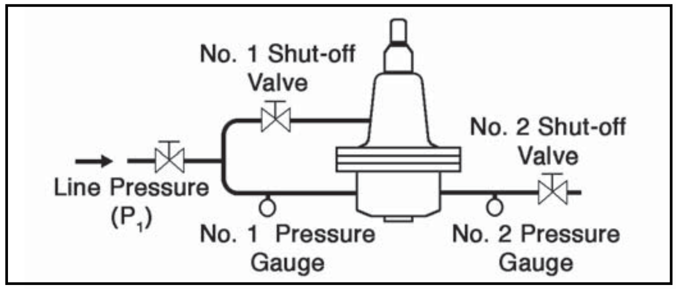


Figure 2: Recommended Bench Test Piping Schematic for HP-1+6+S

2. Check regulator performance: With Step No. 1 conditions met, open and close No. 2 shut-off valve to check regulator's performance for smoothness and repeatability.

3. Proof test to check for external leakage:

   a. Build inlet pressure to 1-1/2 times maximum outlet pressure; but not to exceed 1-1/2 times the Max. Outlet and Spring Chamber Pressure Rating (See HP-S-DIFF TB, Table 2). Close No. 2 shut-off valve and crack open No. 1 shut-off valve until full inlet pressure exists in the spring chamber (2) and downstream line (No. 2 gauge will register same pressure as No. 1 gauge).

   b. Spray the entire regulator with a liquid leak detector and visually inspect for external leakage. Repair unit if leak is detected. See SECTION VI MAINTENANCE.

   c. To relieve all pressures simultaneously (preventing diaphragm (12) damage due to excessive ΔP across diaphragm (12)), crack open No. 2 shut-off valve and shut off inlet pressure. This will uniformly bleed off all pressure contained within the regulator.

4. Return to Section II for Installation and Section IV for Startup.

SECTION VII

VII. TROUBLE SHOOTING GUIDE

1. Erratic operation; chattering.

Possible Cause	Remedy
A. Oversized regulator; inadequate rangeability.	A1. Check actual flow conditions, resize regulator for minimum and maximum flow. A2. Increase flow rate. A3. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union. A4. Install next step higher range spring. Contact factory. A5. Before replacing regulator, contact factory.
B. Worn piston; inadequate guiding.	B. Replace trim.
C. Weakened/broken piston spring.	C. Replace piston spring. Determine if corrosion is causing the failure. If so, consider NACE acceptable trims.
D. Unstable loading pressure.	D. Stabilize loading pressure; i.e. pump, control valve, etc.

2. Downstream pressure will not reach desired setting.

Possible Cause	Remedy
A. Regulator undersized;	A1. Confirm by opening bypass valve together with regulator. A2. Check actual flow conditions, resize regulator; if regulator has inadequate capacity, replace with larger unit.
B. Plugged trim.	B. Remove trim and check for plugged holes in cylinder.
C. Incorrect range spring (screwing in adjusting screw CW does not bring pressure up to proper level).	C. Replace range spring with proper higher range. Contact factory.
D. Too much proportional band (droop); outlet (P_2) pressure droops below load pressure (P_{LOAD}).	D1. Review Proportional Band (droop) expected. D2. Contact factory.
E. Restricted diaphragm movement.	E. Ensure no moisture in spring chamber at temperatures below freeze point.

3. Leakage through body spacer vent hole, or mixing of fluids.

Possible Cause	Remedy
A. Normal-life diaphragm failure.	A1. Replace diaphragm. A2. Check actual flow conditions, resize regulator; if regulator has inadequate capacity, replace with larger unit.
B. Abnormal short-life diaphragm failure.	B1. Can be caused by excessive chattering. See VII - 1. to remedy chatter. B2. Can be caused by corrosive action. Consider NACE acceptable trims. B3. Ensure not subjecting to over-temperature conditions. B4. Downstream outlet (P_2) pressure buildup occurring that overstresses diaphragms. Protect with safety relief valve. B5. Inlet (P_1) pressure valve is shutoff while loading (P_{LOAD}) pressure is still on.

4. Excessive pressure downstream.

Possible Cause	Remedy
A. Regulator not closing tightly.	A1. Inspect the seating. Replace if depressed, nicked or embedded with debris. A2. Inspect guides in body cap. If damaged, replace body cap and/or piston.
B. Downstream block.	B. Check system; isolate (block) flow at regulator inlet - not outlet. Relocate regulator if necessary.
C. No pressure relief protection.	C. Install safety relief valve, or rupture disc.
D. Restricted diaphragm movement.	D1. Ensure no moisture in spring chamber at temperatures below freeze point.

5 Sluggish operation.

Possible Cause	Remedy
A. Plugged body spacer vent hole.	A. Clean vent opening.
B. Plugged piston balance port.	B. Remove trim and clean balance port.
C. Fluid too viscous.	C. Heat fluid. Contact factory.

6. Excessive seat leakage.

Possible Cause	Remedy
A. Foreign matter on seating surface, erosion of seating surface.	A. Inspect and replace damaged parts.
B. Quad ring/backup ring damaged, scratched body cap.	B. Inspect and replace damaged parts.
C. Cylinder gasket damaged.	C. Inspect and replace damaged part.

SECTION VIII

VIII. ORDERING INFORMATION
NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM"), a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).

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NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.

⚠ CAUTION

Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

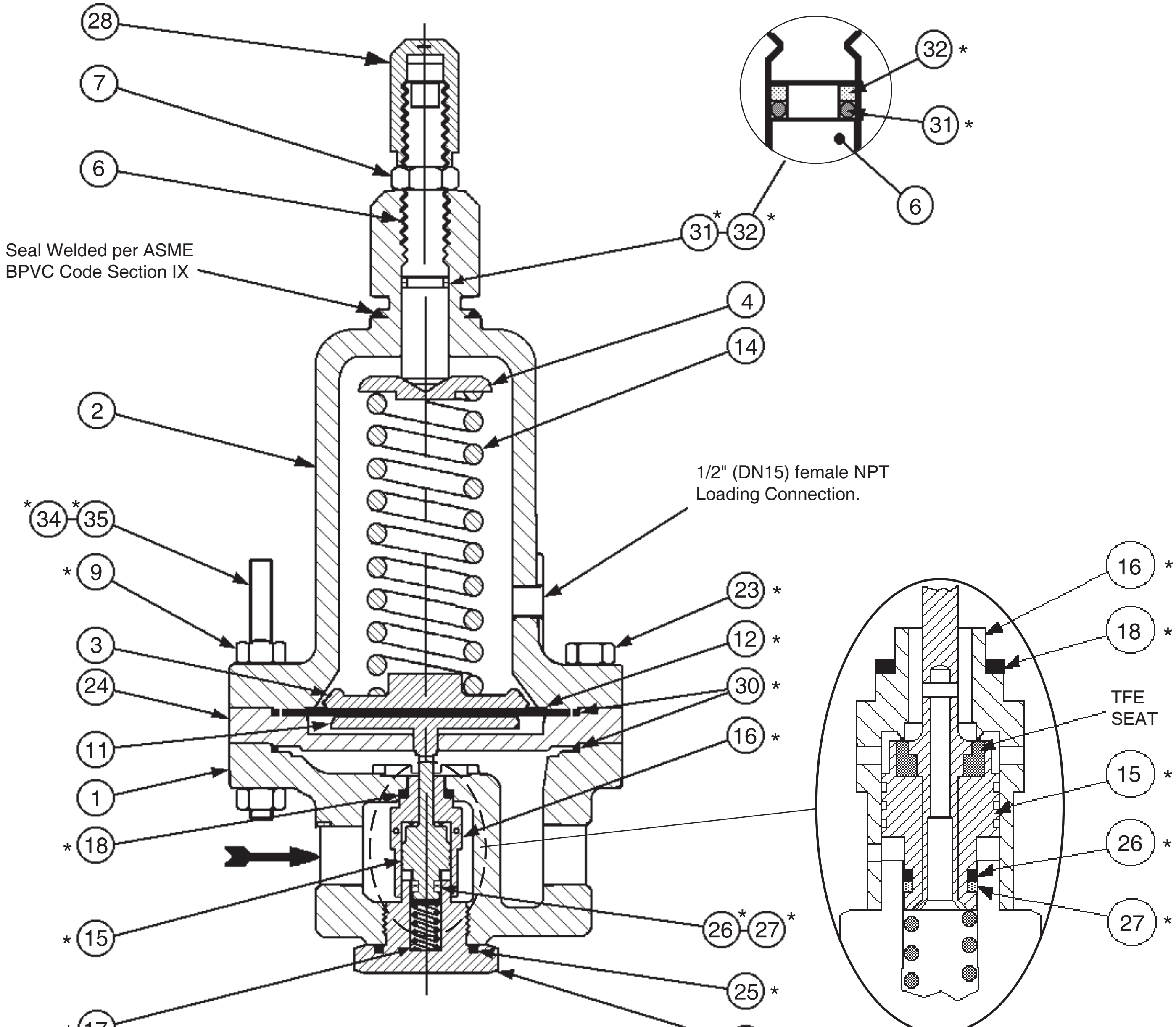

FIGURE 3
Model HP-1+6+S

Item No.	Description	Repair Parts
1	Body	
2	Spring Chamber	
3	Pressure Plate	
4	Spring Button	
5	Body Cap	
6	Adjusting Screw	
7	Lock Nut	
9	Flange Stud Nut	*
11	Pusher Plate	
12	Diaphragm	*
14	Range Spring	

Item No.	Description	Repair Parts
15	Piston w/ TFE Seat	*
16	Cylinder	*
17	Piston Spring	*
18	Cylinder Gasket	*
23	Cap Screw	*
24	Body Spacer	
25	Body Cap O-Ring	*
26	Quad Ring	*
27	Backup Ring	*
28	Closing Cap	
30	O-ring (2 req'd)	*
31	Quad Ring	*
32	Backup Ring	*
34	Stud	*
35	Stud	*

ATEX 94/9/EC: Explosive Atmospheres and Cashco Inc. Regulators

NOTICE

Only for Product Codes wherein hazard category ATEX has been selected.

These valves satisfy the safety conditions according to EN 13463-1 and EN 13463-5 for equipment group IIG 2 c.

Caution: Because the actual maximum temperature depends not on the equipment itself, but upon the fluid temperature, a single temperature class or temperature cannot be marked by the manufacturer.

Specific Precaution to Installer: Electrical grounding of valve must occur to minimize risk of effective electrical discharges.

Specific Precaution to Installer: Atmosphere vent holes should be plugged to further minimize the risk of explosion.

Specific Precaution to Maintenance: The Valve Body/ Housing must be regularly cleaned to prevent buildup of dust deposits.

Specific Precaution to Maintenance: Conduct periodic Continuity Check between Valve Body/ Housing and Tank to minimize risk of electrical discharges.

Attention: When repairing or altering explosion-protected equipment, national regulations must be adhered to. For maintenance and repairs involving parts, use only manufacturer's original parts.

ATEX requires that all components and equipment be evaluated. Cashco pressure regulators are considered components. Based on the ATEX Directive, Cashco considers the location where the pressure regulators are installed to be classified Equipment-group II, Category 3 because flammable gases would only be present for a short period of time in the event of a leak. It is possible that the location could be classified Equipment-group II, Category 2 if a leak is likely to occur. Please note that the system owner, not Cashco, is responsible for determining the classification of a particular installation.

Product Assessment

Cashco performed a conformity assessment and risk analysis of its pressure regulator and control valve models and their common options, with respect to the Essential Health and Safety Requirements in Annex II of the ATEX directive. The details of the assessment in terms of the individual Essential Health and Safety Requirements, are listed in Table 1. Table 2 lists all of the models and options that were evaluated and along with their evaluation.

Models and options not listed in Table 2 should be assumed to not have been evaluated and therefore should not be selected for use in a potentially explosive environment until they have been evaluated.

Standard default options for each listed model were evaluated even if they were not explicitly listed as a separate option in the table. Not all options listed in the tables are available to all models listed in the tables. Individual TB's must be referenced for actual options.

When specifying a regulator that is to be used in a potentially explosive environment one must review the evaluations in Table 1 and 2 for the specific model and each and every option that is being specified, in order to determine the complete assessment for the unit.

A summary of the models and options found to have an impact on ATEX assessment due to potential ignition sources or other concerns from the ATEX Essential Health and Safety Requirements, are listed below.

1. The plastic knob used as standard on some models, (P1, P2, P3, P4, P5, P7, 3381, 4381, 1171, and 2171) is a potential ignition source due to static electricity. To demonstrate otherwise, the knob must be tested to determine if a transferred charge is below the acceptable values in IEC 60079-0 Section 26.14 (See items 25, 27, and 28 in Appendix A). Until the plastic knob has been shown to be acceptable, then either the metal knob option, or a preset outlet pressure option is required to eliminate this ignition source (See items 45 and 64 in Tables).

2. The pressure gauges offered as options on a few of the regulator models (DA's, P1-7, D, 764, 521), use a plastic polycarbonate window that is a potential ignition source due to static electricity. To demonstrate that the gauges are not a potential source of ignition, the gauges would need to be tested to determine if a transferred charge is below

indicating the gauge is compliant with the ATEX Directive (See items 26, 27, and 28 in Appendix A). Until compliance is determined, regulators should not be ordered with pressure gauges for use in potentially explosive environments.

3. Tied diaphragm regulators with outlet ranges greater than 100 psig should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere (See item 6 in Table 1).

4. Regulators must be ordered with the non-relieving option (instead of the self-relieving option) if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving option vents process gas through the regulator cap directly into the atmosphere while the non-relieving option does not. Using regulator with the self- relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.

5. Regulators with customer supplied parts are to be assumed to not have been evaluated with regard to ATEX and thus are not to be used in a potentially explosive environment unless a documented evaluation for the specific customer supplied parts in question has been made. Refer to Table 1 for all models and options that have been evaluated.

Product Usage

A summary of ATEX related usage issues that were found in the assessment are listed below.

1. Pressure regulators and control valves must be grounded (earthed) to prevent static charge build-up due to the flowing media. The regulator can be grounded through any mounting holes on the body with metal to metal contact or the system piping can be grounded and electrical continuity verified through the body metal seal connections. Grounding of the regulator should follow the same requirements for the piping system. Also see item 30 in Table 1.

2. The system designer and users must take precautions to prevent rapid system pressurization which may raise surface temperatures of system components and tubing due to adiabatic compression of the system gas.

3. Heating systems installed by the user could possibly increase the surface temperature and must be evaluated by the user for compliance with the ATEX Directive. User installation of heating systems applied to the regulator body or system piping that affects the surface temperature of the pressure regulator is outside the scope of this declaration and is the responsibility of the user.

4. The Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may rise under any operating conditions. If a process gas temperature rise is possible under operating conditions, then the system designer must investigate whether the regulator body and downstream piping may increase in temperature enough to create a potential source of ignition.

The process gas expansion is typically modeled as a constant enthalpy throttling process for determining the temperature change. A Mollier diagram (Pressure – Enthalpy diagram with constant temperature, density, & entropy contours) or a Temperature – Entropy diagram with constant enthalpy lines, for the process gas, can be used to determine the temperature change. Helium and hydrogen are two gases that typically increase in temperature when expanding across a regulator. Other gases may increase in temperature at sufficiently high pressures.

Product Declaration

If the above issues are addressed by selecting options that do not have potential sources of ignition, avoiding options that have not been assessed, and by taking the proper usage issue precautions, then Cashco regulators can be considered to be a mechanical device that does not have its own source of ignition and thus falls outside the scope of the ATEX directive.

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